

On the combination of embroidered electrodes and gold nanoparticles for ammonia sensing in an eco-friendly system

Gas sensing is a promising research area in air quality/disease/food monitoring. This is related to the detection of various compounds characteristic of the area under analysis. For example, in the healthcare sector, the investigation of breath compounds could be indicative of a patient's health status. The standard equipment for testing exhaled air is laboratory related, cumbersome and expensive, thus limiting its potential usage. In this regard, breath analysis represents a valuable indicator for medical evaluation. In fact, it is considered a fingerprint of various illnesses.

In this work, we propose an ammonia sensor which comprises a cotton fabric as substrate, gold nanoparticles (AuNPs) as sensitive layer and embroidered thread as conductive electrodes. The choice of the textile guarantees a green and flexible material with a fiber-based structure capable of increasing the surface-to-volume-ratio, thus the interaction sites. AuNPs are eligible for gas sensing since citrate, used as capping agent, creates suitable Van der Waals bonding with aminic groups. A skin-friendly, comfortable and biocompatible thread was used for sewing an interdigitated structure on the textile. The present study reports on the different fabrication (synthesis, deposition and embroidery) and characterization steps (electrical investigation) of the system. EIS (electrical impedance spectroscopy) measurements have been conducted for analysing the sensor model and comparing the response of the device in the presence of the analyte (Fig. 1). In particular, the magnitude plot over a 10^0 - 10^6 frequency range reveals a change from 10^8 - 10^5 in the dry state to 10^3 Ohm in the presence of ammonia drops on cotton. Although more tests and extensive investigations need to be conducted to calibrate the sensor and determine its sensitivity and selectivity, these preliminary results suggest that the combination of AuNPs-coated textiles and conductive embroidered thread is a promising and eco-friendly system for gas sensing.

Index terms: embroidered electrodes, gold nanoparticles, ammonia sensing, textile sensor

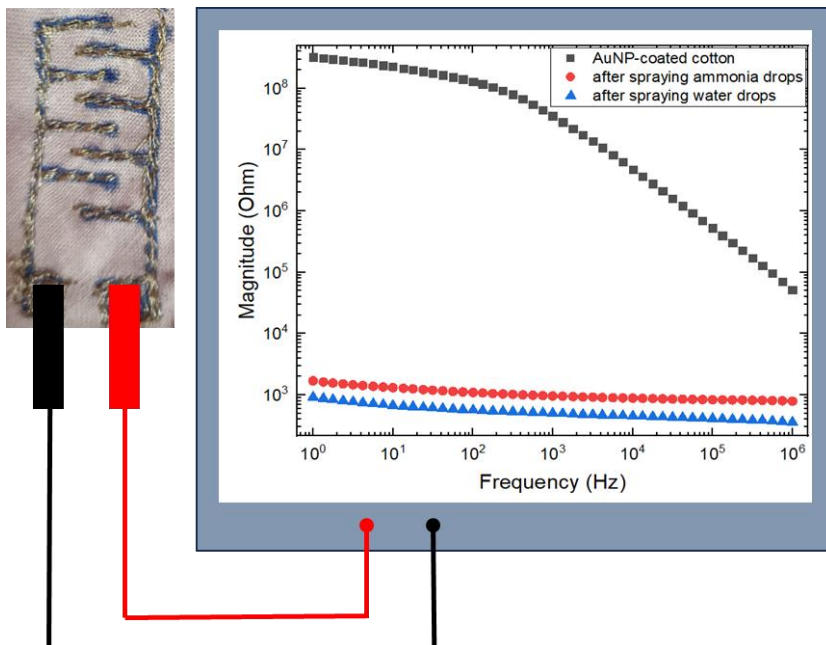


Fig. 1: Illustrative setup for electrical measurements: the textile sensor is connected to the impedance analyzer through alligator cables. The figure on the left reports the results achieved with our sensor.